NOTE

Some models are equipped with electric drain valves that do not require air or water pressure connections.

9. Connect the drain line to the connection in the BOTTOM of the automatic drain valve. The threaded connection in the side of the automatic drain valve is a cleanout hole only.

10. The Miltrol timer is equipped with a step-down transformer to lower the voltage at the contact fingers to 24 volts. Some electrical components in the timer operate on 24 volts (the lamps, timer relays, water valves, etc.). Provide a line disconnect switch for each washer, so any washer in your installation can be turned off for repairs without affecting the operation of the others.

11. Adjust the level control for the desired high- and low-water levels. The level control is set at the factory to deliver the approximate water depths. However, the final adjustment must be made in the field.

12. Connect the supply injector unit to a source of water for flushing. Use one size larger if the pipe run is more than 5 feet. When the water piping for the supply injector is too small, the supply injector does hot flush the supplies properly. When available, hot water should be used for flushing but only if your hot-water source is dependable, has at least 20-psi pressure, and does not occasionally boil over and produce steam in the hot waterline. If hot water is not available, use cold water.

13. Five solenoid valves are within the supply injector. These valves can handle a maximum of 30 psi. They are adequately protected against higher pressure by the pressure-reducing valve that has been properly set at the factory to deliver between 25 to 28 psi. Be sure to check the pressure gauge and reset it to 25 to 28 pounds, as vibration and/or handling in shipment may cause the regulator to get out of adjustment.

Maintenance and Repair

The Milnor washer should be inspected at regular intervals to ensure that it works properly. If an inspection reveals adjustments or repairs are needed, they should be made promptly.

The inspection of a washer should ensure that proper conditions exist. These conditions include the following:

The machine is level.

- All bolts, nuts, and screws are tight.
- Latches on cylinder doors work properly.
- The thermometers are accurate.
- Switches are properly adjusted and working correctly.
- Timers are in good working order.
- Water level gauges are correct.
- All electric controls are working.

In addition to the regular scheduled inspections, you should make special inspections as follows:

EVERY 2 MONTHS:

- Check the gearbox oil level and replenish with fresh oi I, if necessary.

SEMIANNUALLY:

- Lubricate the clutch drag spring with two or three drops of light machine oil between the left-hand chassis end frame and the chart drag spring holder, a shown by arrow (1) in figure 5-11.

ANNUALLY:

- Drain the gearbox and replenish it with fresh oil. The drain plug in the bottom of the gearbox has a small magnet in its end to attract metallic particles in the oil. Be sure to clean off the magnet each time the gearbox is drained and before reinserting the drain plug.
- Clean the motor clutch assembly, as shown by arrow 2 in figure 5-11, with one or two squirts of Navy-approved nonflammable cleaning fluid. Wipe the fluid off with a clean, dry rag and lubricate with two or three drops of light machine oil to prevent the clutch spring from "gumming up" and allowing the clutch to slip. Wipe off excess lubricant.

Troubleshooting

The washer is a rugged machine, but from time to time you can expect trouble. A troubleshooting chart for the Milnor washer is contained in table X of appendix II of this TRAMAN.

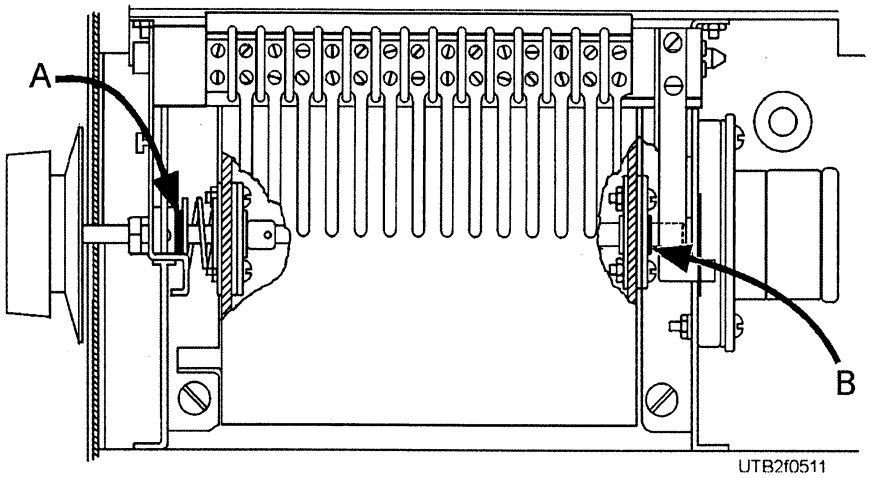


Figure 5-11.—Lubrication and cleaning points on timer.

EXTRACTOR

The purpose of the extractor is to extract water from clothes after rinsing. Water is extracted by spinning the clothes at a high speed, applying centrifugal force, pushing the water to the outer surface, and discharging it through small holes in the basket of the extractor to drain.

Extractors may be equipped with a manual brake (fig. 5-12) or an automatic brake. An assembly drawing of a manual brake stainless steel extractor is shown in figure 5-13.

Installation

The procedure for installing extractors varies with different makes and models. Consult the manufacturer's manual for specific instructions on the model that you are installing. These machines may be installed on any good floor or foundation, and they operate without excessive vibration if properly leveled and bolted down.

When installing the extractor, you should pay special attention to the following:

- Support the extractor so it is 1 inch above the foundation. Ensure there is 100 percent contact between the hold-down pads and the grout for leveling the extractor.
- Check the nameplate before connecting the electrical source to ensure the proper power source is connected.
- If the extractor is equipped with an automatic brake, which is operated by air, ensure the proper air supply pressure is connected.
- When connecting the drain piping, you should install a short piece of hose on the drain line near the extractor to avoid possible problems due to vibration of the unit.
- Ensure the rotation of the basket is in the clockwise direction as shown on the nameplate.
- Once installation is complete, thoroughly clean the inside of the basket to remove the dust and grime that have accumulated during shipment.

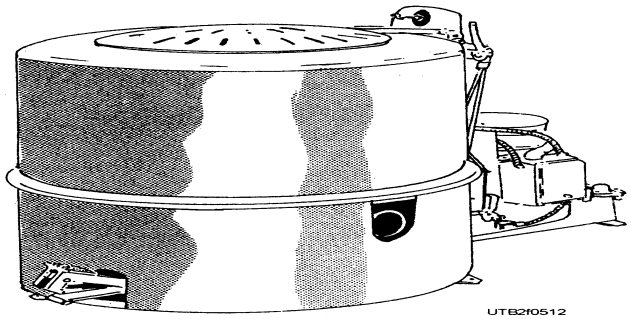


Figure 5-12.—A manual brake extractor.

Maintenance and Repair

If the extractor is to give satisfactory service for a long period of time, it should be properly maintained and repaired promptly. Maintenance and upkeep of the Milnor extractor requires the following:

- The extractor rubbers should be checked at regular intervals. When necessary, the rubbers should be tightened or replaced.

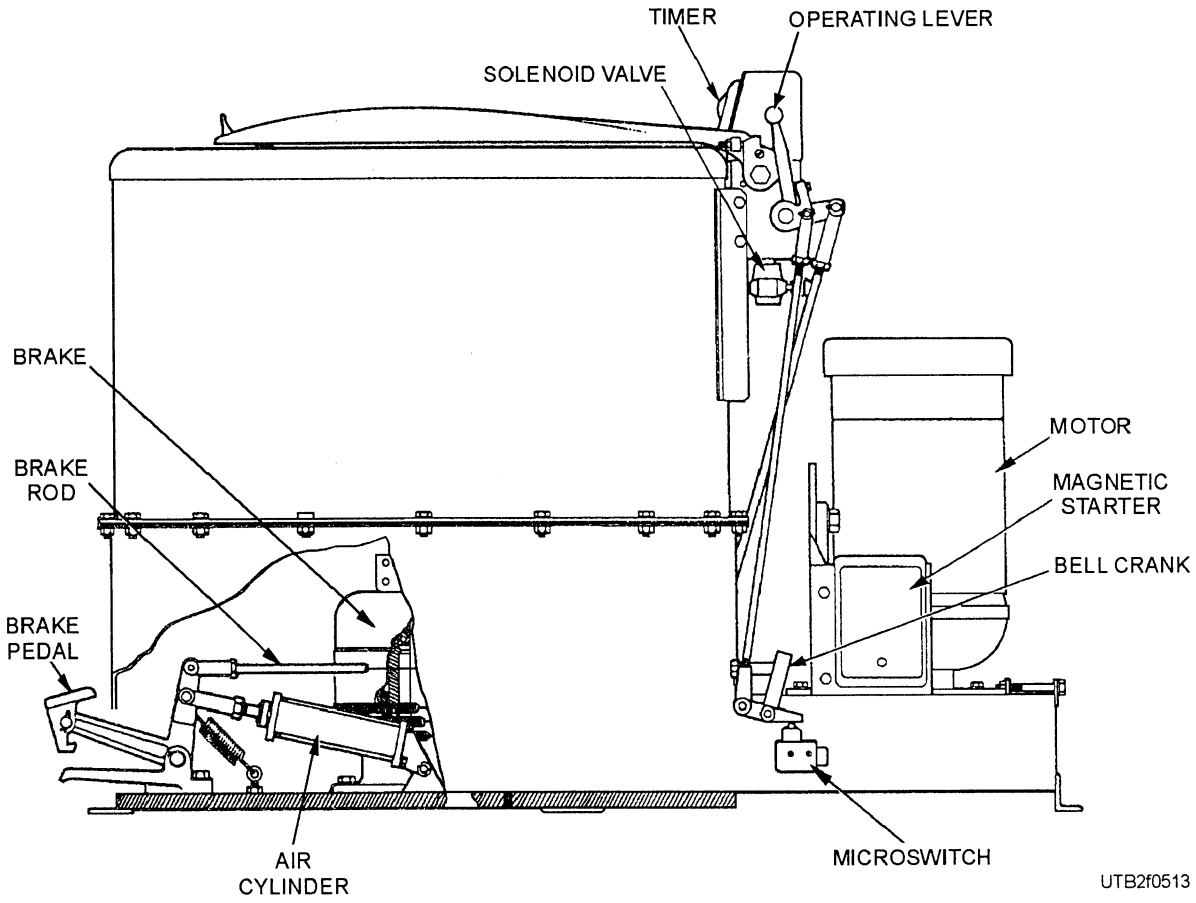


Figure 5-13.—An assembly drawing of a manual brake stainless steel extractor.

- Remove the basket from the spindle. The basket is held to the spindle with a locknut on the inside of the basket, and the shaft and basket are fitted together with a taper. The basket may be removed from the spindle by "jolting" it off of the spindle or, if the extractor has been in service for a long period of time, you may have to press the basket off of the spindle. Next, remove the pulley, loosen the packing nut, and remove the bearing housing assembly with its shaft and bearings, after which new rubbers may be installed and the extractor assembled in reverse order. When installing new rubbers, be sure to place the flat face of the rubbers so they face the flange on the bearing housing; this will ensure that the concave side of the rubbers is down on the lower rubber and up on the upper rubber.

- Ensure the extractor is lubricated at all points recommended by the manufacturer. Also, use lubricants approved by the manufacturer. As for the frequency, lubricate every 30 days or as experience dictates.

Troubleshooting

In troubleshooting the extractor, you must be able to recognize common troubles and know the possible causes of the trouble. Obviously, a lot of time may often be saved if the cause is found before any corrective action is started. Table X of appendix II will be useful to you as a guide in finding the sources of troubles in Milnor extractors.

TUMBLER

The tumbler, also called the "drying tumbler," is the machine used in Navy laundries to remove moisture from materials. The efficient removal of moisture by the tumbler provides material that can be ironed properly. There are various brands of tumblers manufactured by such companies as Cissell and Huebsch.

The Huebsch Loadmaster model 42-inch tumbler is often used at Navy activities. This is a commercial type of tumbler with a drying capacity of 100 pounds (dry weight) of laundry per hour. A two-motor drive system provides independent fan and cylinder operation. A one-way cylinder rotation and a door safety switch are standard.

Another type of tumbler used at Navy activities is the Cissell model 36-inch tumbler. This tumbler has a drying capacity of 50 pounds (dry weight) of laundry per hour. This tumbler can have heat for drying supplied by a oil-fired burner attached to the unit or supplied by a permanent plant source. It also has a "cool down" feature for permanent press and other modern-day fabrics.

Installation

The following instructions on the installation, maintenance, and repair of tumblers apply to the Huebsch Loadmaster model 42-inch tumbler. Always consult the manufacturer's instructions for the brand and model that you are installing.

When installing the tumbler, you should ensure the following:

- Ensure the tumbler is level and properly secured to the floor. In leveling, use shims of adequate size to avoid weight concentration.
- The dryer room must be well ventilated. An opening of 2 square feet to the atmosphere must be supplied for each 1,700-cubic-feet per minute (cfm) model and 4 square feet for each 3,000-cfm model. Allow adequate clearance on all sides for servicing and efficient loading and dispatching of dried materials.
- On steam-heated laundry tumblers, a minimum of 100 psi should be maintained for efficient performance. Connect 3/4-inch steam supply and return lines to the coils as marked on the coil housing.
- Laundry tumblers are factory-wired for operation and require only a power supply connection.
- A fused disconnect should be installed. For multiple-tumbler installations, each unit should be equipped with a disconnect switch.
- Ensure the fan rotation is correct.
- For maximum efficiency of single- or multiple-unit installation, air discharge must be ducted individually to the atmosphere by the shortest possible route. For runs less than 20 feet, the duct size must equal the discharge spout or be larger. For each additional 30 feet of duct run, increase the entire duct diameter by one tenth for round duct or the entire duct area by one fifth for rectangle duct. Discharge to the atmosphere must be constructed to get rid of too much back pressure and to prevent the entrance of weather. The end of the duct should be at least one diameter away from any obstacle.
- Check for correct cylinder, belt, and chain adjustment before starting the unit, as described later in this chapter. Turn the power on and start the tumbler to check the cylinder and fan rotation and the door switch adjustment.
- Turn the steam on. Place a load of damp rags in the cylinder and run until dry. Check the cylinder adjustment under load and check for vibration or unusual noise. Reversing models must be checked for correct time delay betweeh reversing cycles. Correct any adjustment before placing the tumbler in service.

Maintenance and Repair

Two views of the tumbler are shown in figures 5-14 and 5-15. Try to keep the tumblers operating at peak efficiency.

Some general maintenance and minor repair procedures in the care and upkeep of tumblers are as follows:

MONTHLY:

- Loose wire connections can cause tumbler failure and possible damage. Remove the control box cover and check the controls.
- Replace the contactor points when pitted or worn. Check and tighten all wire connections, including thermal overload heating coils. Check for secure mounting of controls to the control box.

ANNUALLY:

- Ensure that electric motors are removed and cleaned thoroughly. Frequent tripping of the thermal overload circuit breakers may be caused by low voltage, loose connections, reversed fan, or high ambient temperature. Never increase thermal overload heater size without complete investigation.
- The door switch, thermostat, and other optional electrical equipment require replacement upon failure. After exchange, check the wiring diagram before turning on the power. Check with the power on. Adjust if necessary before returning to service.

ADJUSTMENTS.—In servicing the tumbler, you may have to adjust the belt, chain, cylinder, and

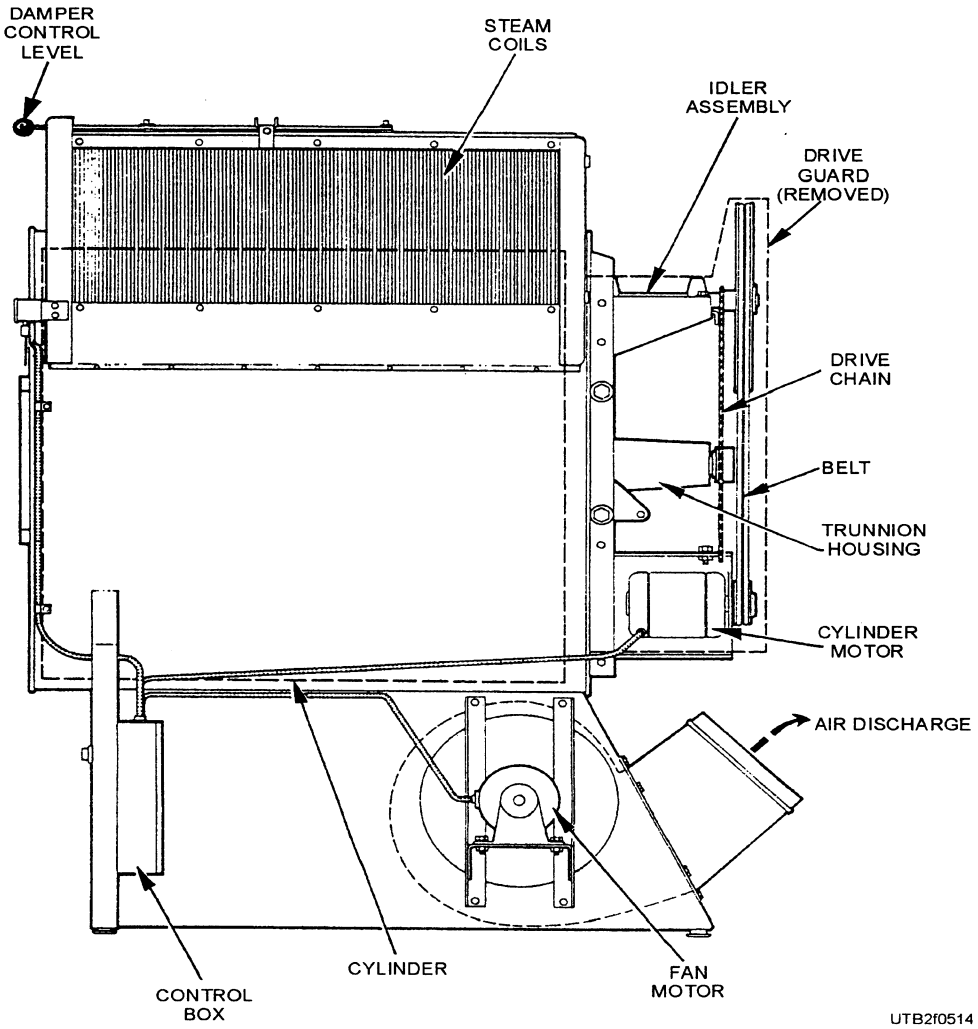


Figure 5-14.—Right side view of tumbler.

reversing timer (on machines so equipped), and door safety switch at various times. To make these adjustments, refer to the manufacturer's instructions for specific procedures.

LUBRICATION.—Once a month, remove the circular cover on the drive guard and oil the chain, using SAE-30 oil. The pillow block, trunnion, and motor bearings are sealed and require no service.

STEAM GENERATOR

The purpose of the steam generator is to provide enough steam to operate tumblers, as well as to provide a continuous supply of hot water to the washers under constant operation. One type of steam generator frequently used in laundries at Navy activities is the Clayton steam generator, Model RO-33-PL.

NOTE

Some portable skid-mounted units use a self-contained oil-fired water heater to supply hot water for washers instead of a steam generator.

The Clayton steam generator is a water-tube boiler that delivers its rated output of 99 percent quality steam (containing less than 1 percent moisture) per hour from 60°F feedwater. The generator develops its full-rated pressure within 5 minutes from a cold start.

The generator features a continuous circulating feedwater system with a constant capacity pump that ensures a wet tube in the generator-heating unit at all times. Automatic controls regulate the feedwater rate

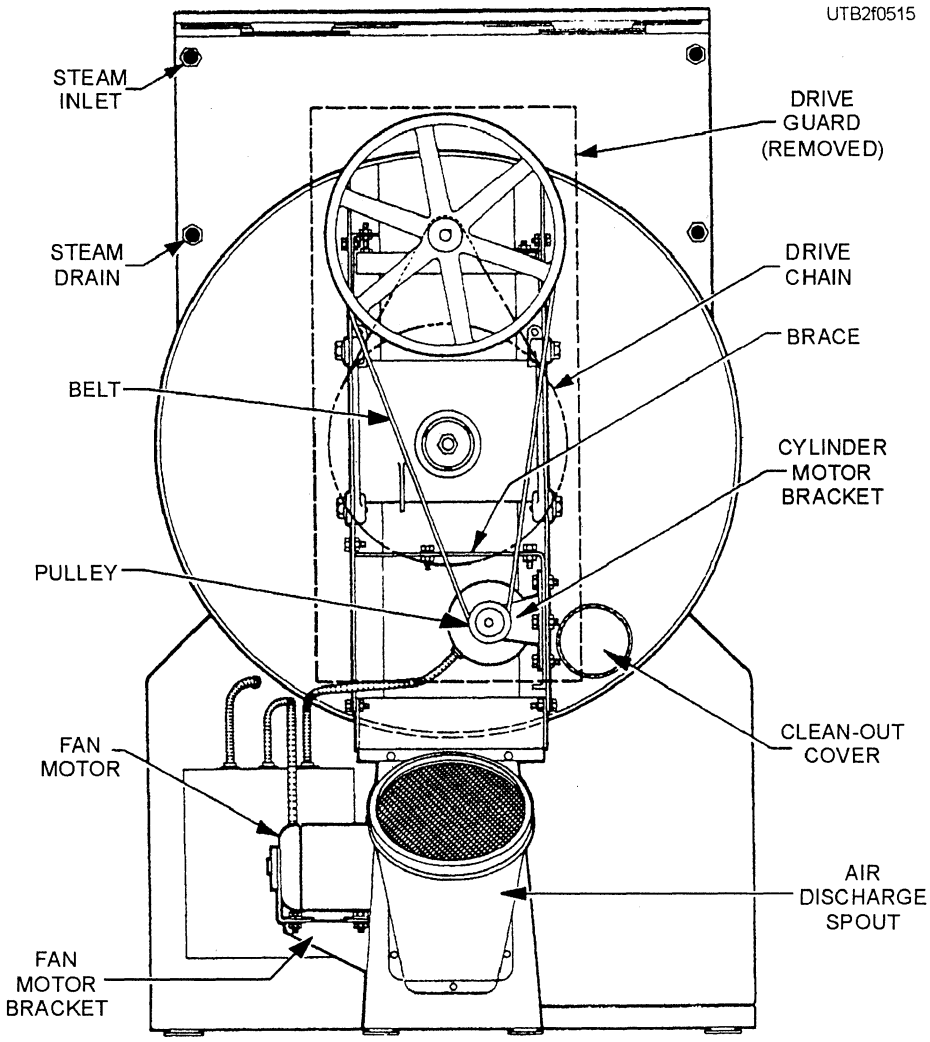


Figure 5-15.—Rear view of tumbler.

and modulate or stop the burner by steam demand. Standard equipment includes safety devices for protection against water fai I ure, burner failure, too much pressure, and electrical overload. A flow diagram of the water and steam circuit of the generator is shown in figure 5-16. Supply water enters the feedwater section of the water pump from the hot well/feedwater tank and is pumped directly to the steam accumulator. The circulating liquid is drawn from the accumulator by the circulating section of the water pump and pumped into the single-passage heating coil, and then back to the accumulator where the steam is separated.

The pump is driven directly by an electric motor and contains no packing boxes. It is arranged in two sections—the feedwater section and the circulating section. The pump diaphragms are operated hydraulically by oil displaced by reciprocating pistons within the pump. A built-in solenoid-operated bypass valve is on the hydraulic pressure section of the feedwater pump to prevent the feedwater section from pumping when the valve is open. The valve is actuated by the water level control according to the liquid level in the accumulator.

Installation

When installing a steam generator, always use the manufacturer's instructions. Pay attention to the fuel, water, electrical, and venting facilities when installing the boiler and ensure the following:

- Ample clearance should be allowed on all sides to make operation and maintenance easier.
- When installing external piping, use pipe unions next to the boiler connections to allow easy removal of parts for inspection and cleaning.
- The boiler is equipped to burn No. 2 diesel fuel oil. Connect the fuel supply line to the inlet connection on the fuel filter. Connect the return

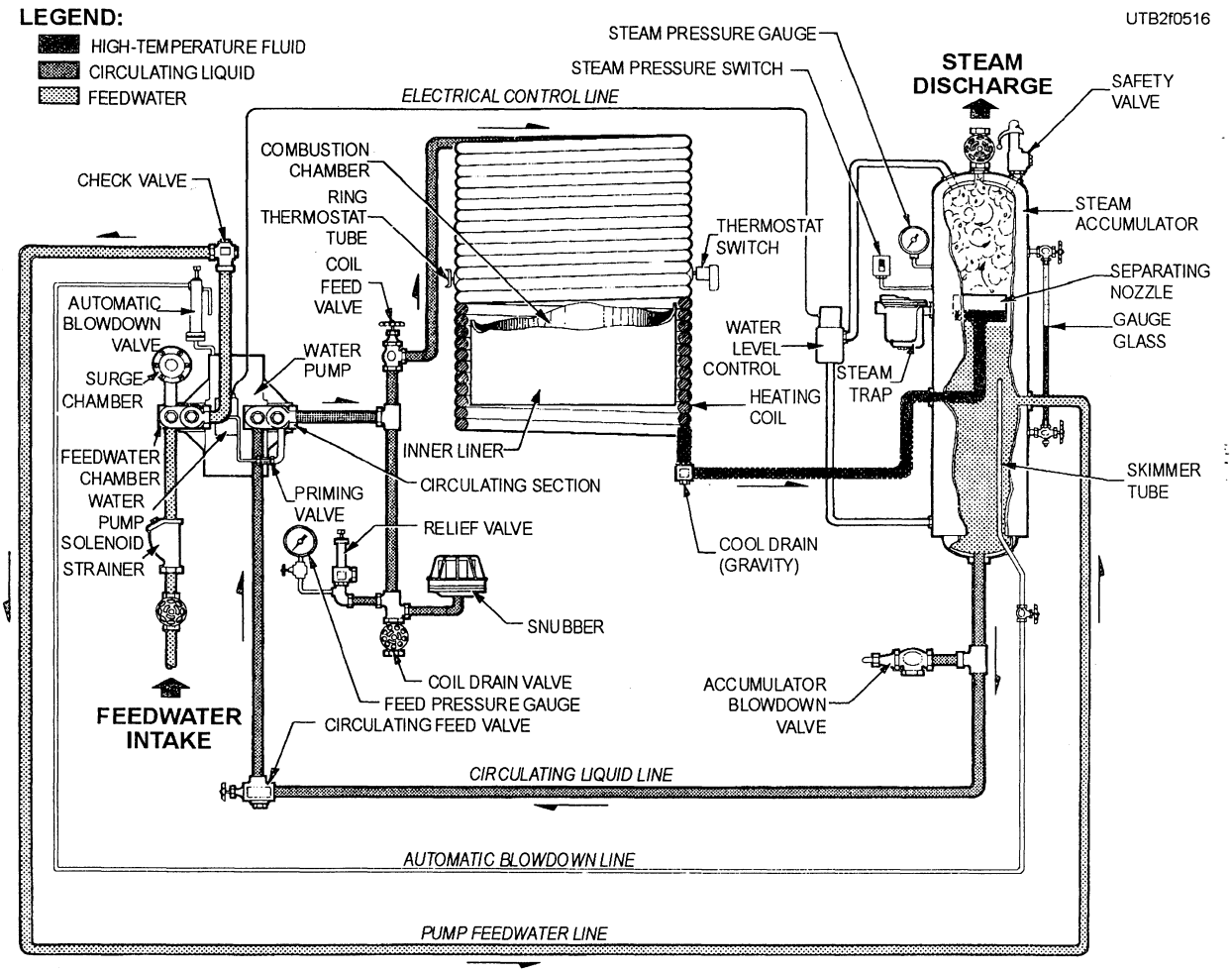


Figure 5-16.—Flow diagram of the water and steam circuit in a generator.

line to the return connection below the fuel pump. The return line must be a separate line back to the fuel tank and NOT connected to the fuel suction line to prevent locking of air in the fuel system that will cause erratic burner operation. Do NOT install a shutoff valve in the return line; however, a swing check valve may be installed if the fuel pump is below the fuel tank.

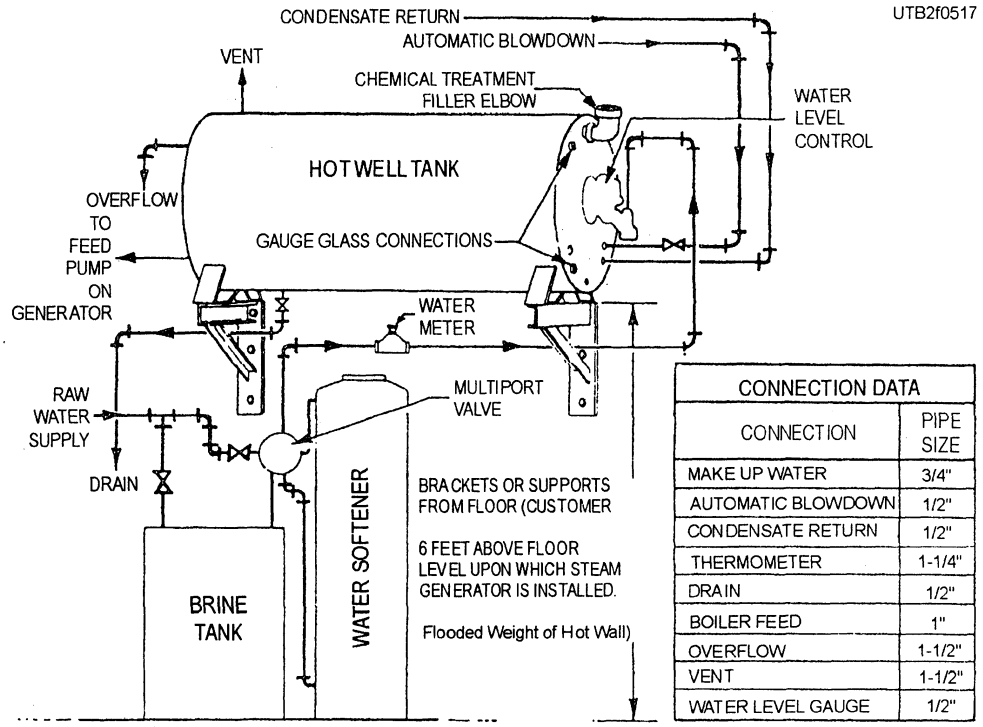
- Install a stack adapter (supplied with the steam generator) directly on the heater cover stack outlet. Install a stack extension if desired, using 12-inch-diameter flue pipe (minimum), and install a weather cap (supplied with the unit) at the top of the flue pipe. If the unit is operated in an enclosed building, extend the flue pipe through the roof and install a weather cap.

- Typical hot-well installation and connection data are shown in figure 5-17. The hot well must be elevated on a suitable stand or bracket to allow a 60-inch gravity feed to the inlet of the feedwater pump check valve housing for hot-well temperatures up to 180°F. If higher hot-well temperatures are anticipated, a higher gravity feed is required to prevent vapor locking of the feedwater pump. For hot-well temperatures of 180°F to 200°F, a 72-inch gravity feed is necessary. Temperatures above 200°F require a gravity feed of 84 inches.

- The feedwater connection is made by connecting a line between the feed pump connection on the hot well and the feedwater intake valve. The connection is made by using a minimum of 1-inch-diameter pipe.

- The steam header should be connected to the steam discharge valve. Ensure that the header pipe size is not smaller than the steam discharge valve.

- A valve bleed line to the atmosphere should be installed at the steam discharge. This design



CONNECTION DATA	
CONNECTION	PIPE SIZE
MAKE UP WATER	3/4"
AUTOMATIC BLOWDOWN	1/2"
CONDENSATE RETURN	1/2"
THERMOMETER	1-1/4"
DRAIN	1/2"
BOILER FEED	1"
OVERFLOW	1-1/2"
VENT	1-1/2"
WATER LEVEL GAUGE	1/2"

Figure 5-17.—A typical installation of horizontal hot-well tank and connection data.

allows the release of steam to permit the steam generator to operate under full load when adjustments are made.

- Connect the pipe accumulator blowdown valve and coil drain valve to waste. These lines may be manifolded into a common line of not less than 1-inch-diameter pipe. Connect the pipe discharge from the steam safety valve to the atmosphere. You should provide a 1/4-inch-diameter (minimum) pipe drain at the lowest point in the safety valve vent line piping.

- The pipe outlet from the accumulator steam trap should be connected to the condensate return connection on the hot well with 3/4-inch-diameter pipe.

- To permit periodic checking of the automatic blowdown valve adjustment, you should install a shutoff valve and a flow test valve, as shown in figure 5-18. Pipe the discharge from the shutoff valve to the automatic blowdown connection on the hot well.

- Make electrical connections to terminals in the electrical control box. Install a disconnect switch in the line next to the steam generator to ease the isolation of electrical components from the line if service is necessary. Start the motor momentarily to check rotation. Rotation should be clockwise as viewed from the front of the plant.

Preventive Maintenance and Repair

Like any piece of mechanical equipment, the steam generator requires proper maintenance and some repairs will be needed to maintain the efficiency and service it is designed to provide. The following discussion covers some of the maintenance and repair requirements for the Clayton steam generator, Model RO-33-PL. For detailed information on the maintenance and upkeep of this and other types of

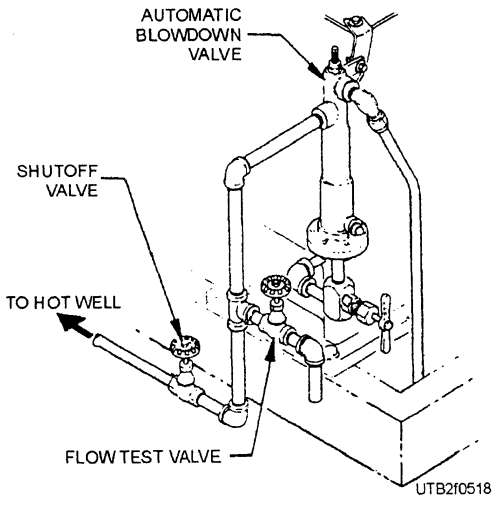
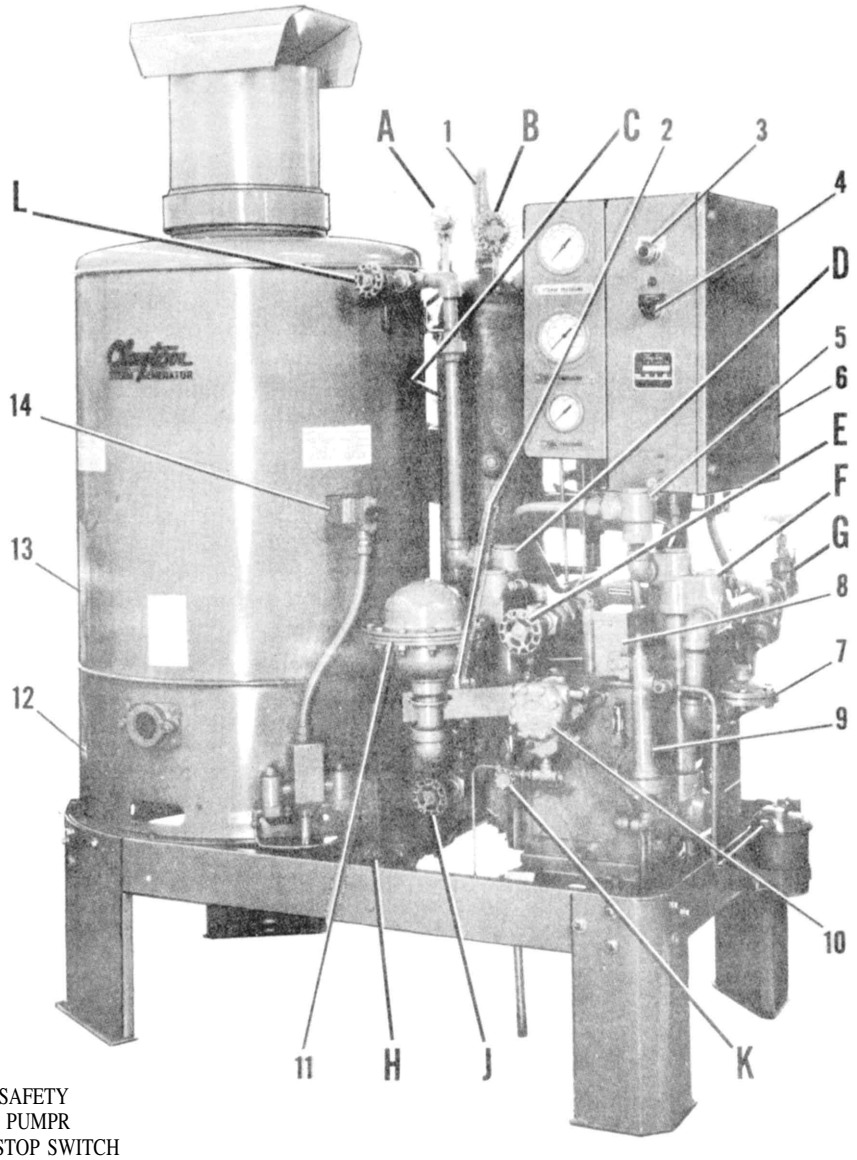


Figure 5-18.—Suggested automatic blowdown valve discharge piping.

generators, consult the manufacturer's instruction manual. Before proceeding, observe that figure 5-19 shows the operating controls and parts as seen from the front of the generator, and figure 5-20 shows the operating controls and parts as viewed from the rear. The letters and numbers shown in parentheses in the sections that follow refer to the name and location of operating controls and parts in figures 5-19 and 5-20.

Some general maintenance and repair requirements for the steam generator are as follows:

- If dirt or lint accumulates on the cupped sides of the blower rotor blades, a shortage of air to the



1. STEAM SAFETY
2. WATER PUMPR
3. START-STOP SWITCH
4. EMERGENCY RUN SWITCH
5. CHECK VALVE
6. ELECTRICAL CONTROLS BOX
7. INTAKE SURGE CHAMBER
8. WATER PUMP SOLENOID
9. AUTOMATIC BLOWDOWN VALVE
10. FUEL PUMP
11. WATERPUMP DISCHARGE SNUBBER
12. BURNER BASE
13. HEATING UNIT
14. THERMOSTAT SWITCH

A. SOOT BLOWER VALVE
B. STEAM DISCHARGE VALVE
C. ACCUMULATOR GAUGE GLASS
D. CIRCULATING PUMP HOUSING
E. CIRCULATING FEED VALVE
F. FEEDWATER PUMP HOUSING
G. FEEDWATER INTAKE VALVE
H. ACCUMULATOR BLOWDOWNVALVE
J. COIL DRAIN VALVE
K. BURNER CONTROL VALVE
L. COIL FEED VALVE

Figure 5-19.—Operating controls and component identification of Clayton steam generator, Model RO-33.PL, front view.

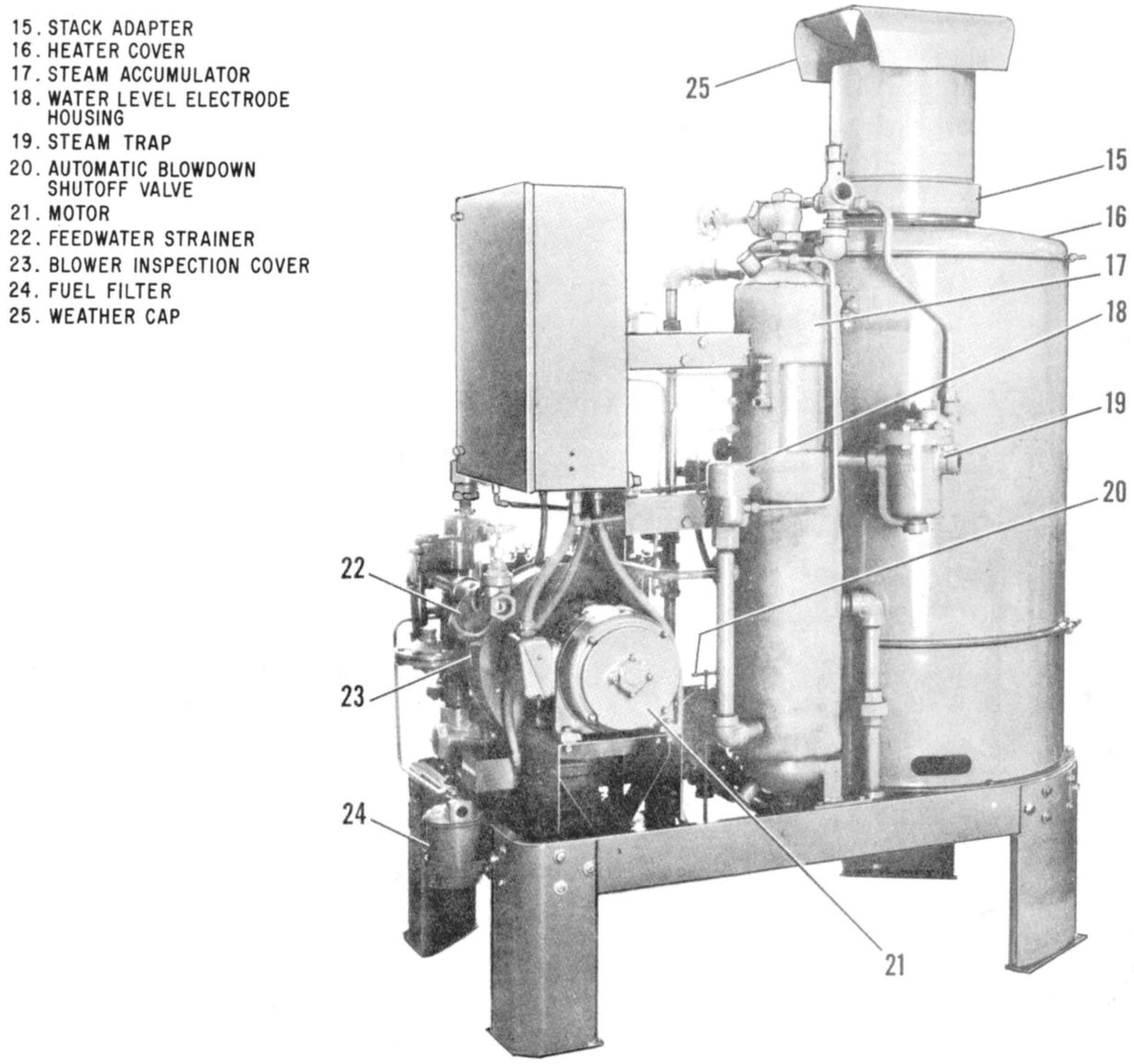


Figure 5-20.—Operating controls and component indentification of Clayton steam generator, Model RO-33-PL, rear view.

burner causes reduced burner efficiency. The frequency of cleaning depends on the amount of dirt or lint in the air at the installation.

- Check the operation of the thermostat control every 100 operating hours. Consult the manufacturer's instructions for test procedures.
- When a water pump is noisy, the trouble is sometimes due to a restricted heating coil that causes excessive feed pressure. The feed pressure should be checked for coil restriction. When checking for coil restriction, compare the reading on the feed pressure gauge with that on the steam pressure gauge. Normal feed pressure may vary slightly with each installation. Carefully note the pressure right after the steam generator is installed, so an accurate check of coil restriction can be made for the unit. The coil is restricted if feed pressure is 30 pounds or more above the normal feed pressure noted immediately after installation or when the coil was completely clean.

The steps of the procedure used to blowdown the system are as follows:

1. With the plant operating at normal steam pressure, close the circulating feed valve (E) and open the coil drain valve (J). Start a time check. After 30 seconds, shut off the burner and close the steam discharge valve (B).

NOTE

If the burner is shut down by the thermostat control during the time check, immediately open the burner control valve (K); then close the steam discharge valve.

2. Open the accumulator blowdown valve (H).

3. When the steam pressure drops to zero, close the coil drain valve (J) and the accumulator blowdown valve (H).

4. Open the circulating feed valve (E).

5. To resume operation, allow the plant to fill with water and start the burner in the normal manner. You may have to reprime the circulating pump after the blowdown. To prime the feedwater pump, refer to the manufacturer's instructions.

Additional inspection and maintenance factors for the steam generator are as follows:

- When the electric motor is equipped with sealed bearings, the bearings are prelubricated for the life of the bearings. However, motors equipped with oil-wick-lubricated bearings should have 1 teaspoon of good grade oil added to the reservoirs every 6 months.

- If the motor is equipped with pressure grease fittings, remove the plug below the motor shaft every 6 months and force a light grade of grease into the port at the top until the clean grease appears at the plug outlet. To prevent rupture of the grease seals, run the motor for 4 or 5 minutes before replacing the plug below the motor shaft.

- Every year (more often under severe operations), drain and refill the water pump crankcase with a good grade of SAE 20 motor oil (about 5 quarts required). With the pump running, oil should show at least halfway in the sight gauge.

- The water pump check valves should also be inspected and cleaned when you remove scale from a restricted heating coil. Check the disks, springs, and valve seats for scale and pitting.

- The relief valve (fig. 5-21) of the water pump should be adjusted to open at about 500-psi feed pressure but remain driptight during operation. Leakage from this valve results in a lack of water to the heating unit and causes overheating. Sometimes when the unit is started, the feed pressure may temporarily rise enough to cause the relief valve to release a small amount of water; however, the feed pressure will return to normal after the unit heats and the system becomes stabilized.

- The water pump discharge snubber (fig. 5-22) is nonadjustable. If the rubber insert has to be replaced, the old insert must be cut away from the retainer. To ease assembly, lubricate the new insert with glycerine (do not use oil) to allow it to be pushed into the retainer and bottom housing.

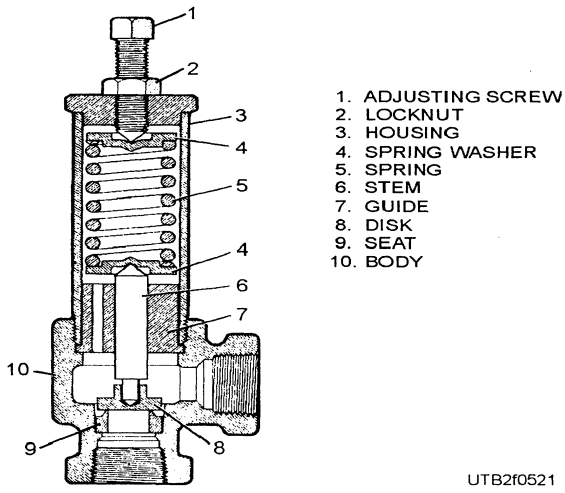


Figure 5-21.—Pump relief valve.

- To keep the ring thermostat control of the generator (fig. 5-23) at peak operation, you may have to adjust the thermostat switch and the thermostat ring channel. The plant must be operated long enough to be thoroughly heated before you adjust the thermostat switch. In making these adjustments, refer to the manufacturer's instructions.

- Adjust the thermostat ring channel (Number 23 of fig. 5-23) when replacing the heating coil or if the original assembly has been disturbed. A careful check of the adjustment must also be made if the thermostat switch cannot be adjusted without erratic response.

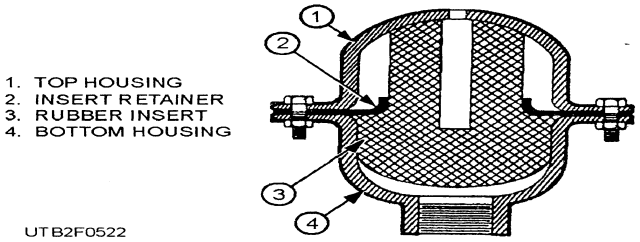


Figure 5-22.—Water pump discharge snubber.

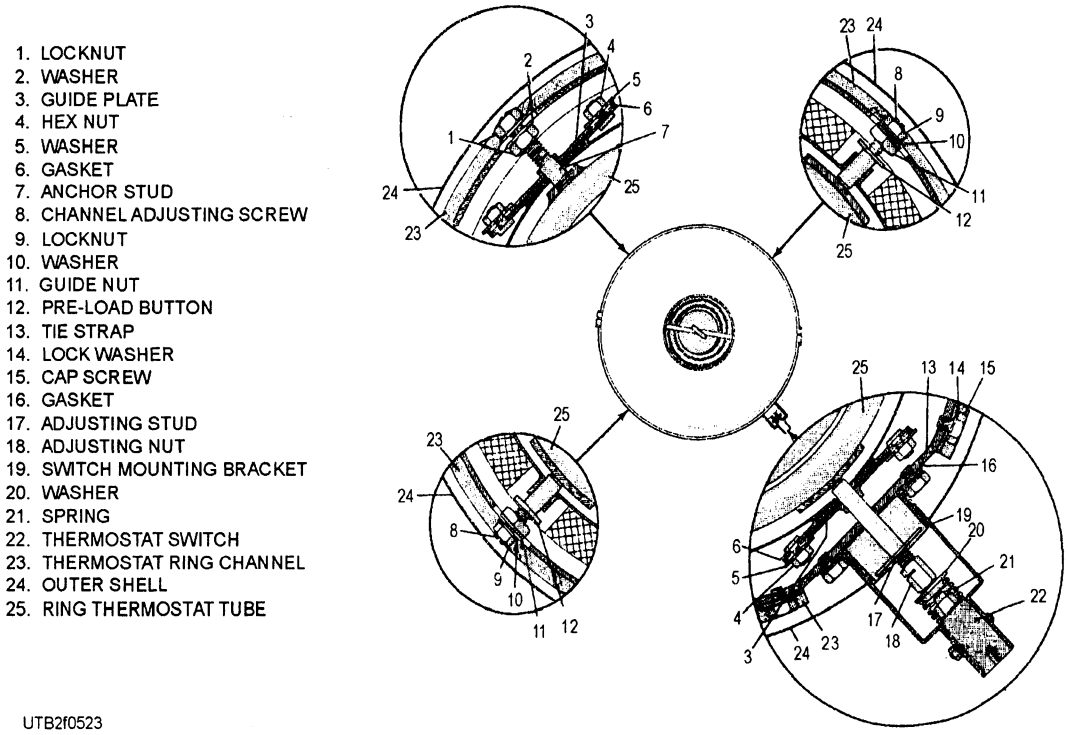


Figure 5-23.—Ring thermostat control.

- The automatic damper should be kept in proper adjustment to ensure a proper supply of air to the burner.
- The burner manifold (fig. 5-24) requires cleaning and adjusting at times to keep it in good shape. Remove the manifold. Scrape carbon deposits from the manifold and ignition electrodes. Clean the burner nozzles and strainer.

CAUTION

When cleaning, you should NOT use a sharp instrument that can scratch or disfigure the tip orifice or slots in the distributor. A slight scratch on these parts can seriously impair nozzle operation.

- Adjust the ignition electrodes to conform with the dimensions shown in figure 5-24. The gap must be positioned as accurately as possible, so it is at the immediate edge of the nozzle spray. Be careful when bending and adjusting the electrodes to avoid cracking the insulators. The insulators may develop an invisible short due to such a fracture, resulting in ignition failure.
- The fuel pressure to the burner must be properly maintained. Excessive fuel pressure causes the burner to smoke and results in sooting of the heating coil. However, if fuel pressure is too low, the plant comes up to pressure slowly and does not maintain adequate steam pressure during periods of maximum steam demand. Adjust the pressure as needed.
- Figure 5-25 shows a drawing of a fuel pressure switch. To adjust the switch, close the light and fuel indicator pilot when fuel pressure rises to about 70 psi by turning the adjusting screw (1) clockwise to increase or counterclockwise to decrease pressure at which the switch closes. This step allows enough pressure to induce proper atomization when fuel is admitted to the burner. Secure the adjusting screw with the locknut after adjustment.
- The steam pressure switch (SPS) can be adjusted to open and stop the burner at any maximum pressure between 65 and 195 psi. The switch closes and restarts the burner when steam pressure drops about 8 psi below that point.
- The modulating pressure switch (MPS) is normally adjusted to modulate the burner to "low-fire" operation when steam pressure reaches 10 psi below maximum and to return the burner to "high-fire" operation when steam pressure drops about 8 psi below that point. The recommended setting of 10 psi below the maximum, in most cases, provides both stable operation and stable steam pressure during fluctuating demand.

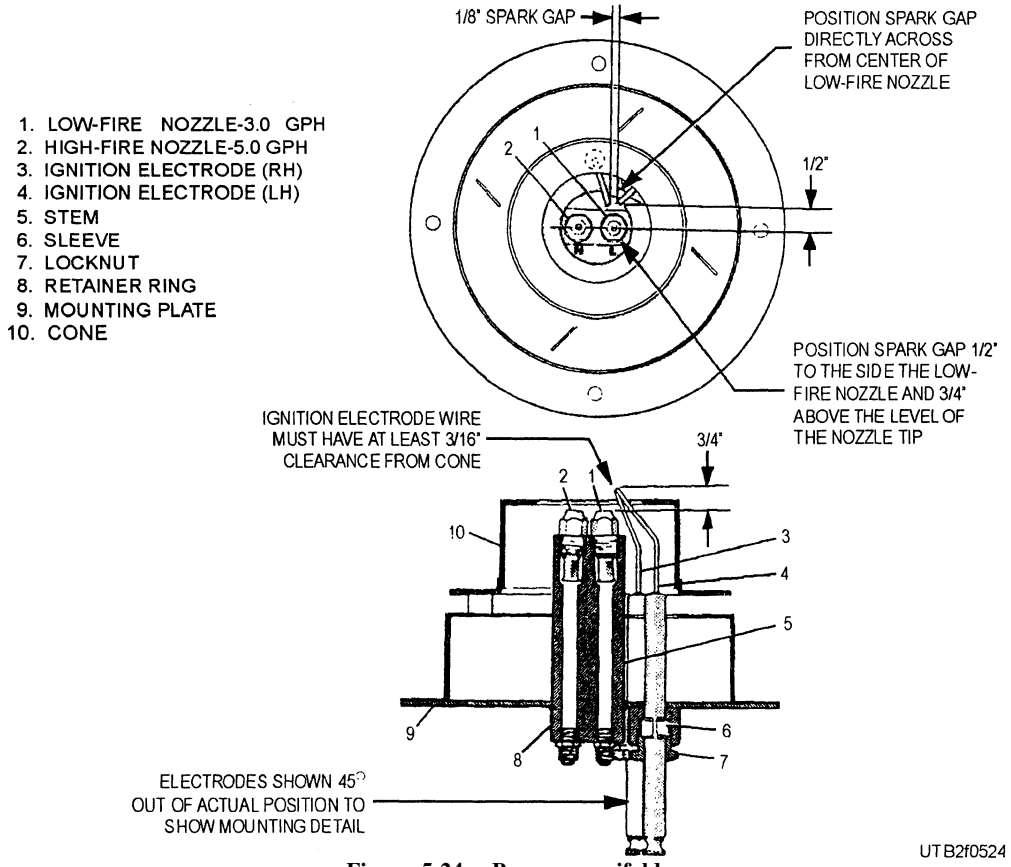


Figure 5-24.—Burner manifold.

- The automatic blowdown valve (fig. 5-26) is operated by oil pressure from the water pump. If the blowdown valve diaphragm gets ruptured, oil will likely appear in the waste discharge. Replace a ruptured valve diaphragm immediately to prevent the loss of oil from the pump crankcase.

- As preventive maintenance, replace the blowdown valve diaphragm whenever the water pump diaphragms are replaced. Since wear may affect the operation of the blowdown valve, dissemble the valve each time the diaphragm is replaced.

Troubleshooting

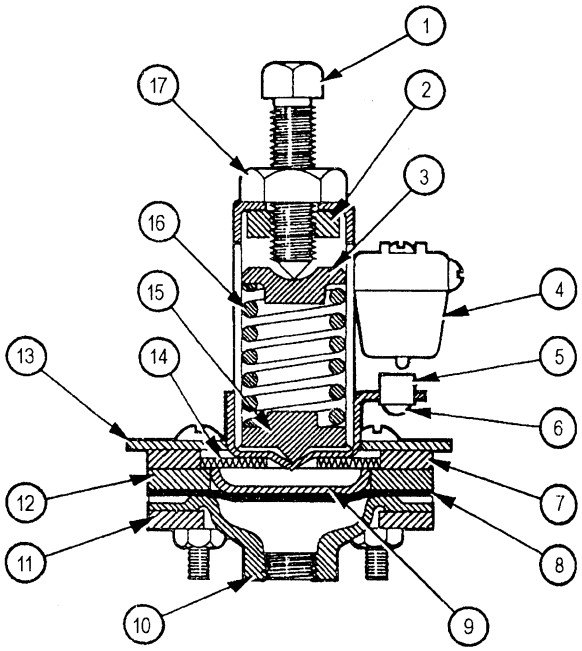
A troubleshooting chart for the Clayton steam generator, Model RO-33-PL, is provided in table S of appendix II. This chart will guide you in finding and correcting troubles in that make and model of generator. You will find similar charts in the instruction manuals provided by the manufacturers of other makes of steam generators. Make sure you are familiar with the manufacturer's manual for the generator used at your activity, and follow the procedures prescribed for the maintenance and repair of the equipment.

RESIDENTIAL WASHING MACHINES

The automatic washer (fig. 5-27), described in this chapter, is typical of the machines on the market today. The circuits and timing diagrams are composites of the more common features found in several different models. For the equipment you are installing or working on, follow the manufacturer's instruction manual.

The automatic clothes washing cycle can be broken down into four basic operations—fill, agitate, spin, and drain. Nearly all of these operations are repeated two or more times throughout a complete washing cycle and, for the most part, are controlled by a timing assembly.

The FILL operation begins immediately after starting the washer, but the timer does not start until the water level is at the proper height. Some models use timed-fill operations that start and end under the control of the timer of the washer. Also, note that there are no timed-fill operations. This type of washer uses a no timed-fill feature initiated by the timer but



LEGEND:

1. ADJUSTING SCREW
2. NUT PLATE
3. SPRING WASHER
4. SWITCH
5. LEAF SPRING
6. SPRING GUIDE
7. GUIDE RING
8. DIAPHRAGM
9. DIAPHRAGM WASHER
10. BASE
11. RING
12. GUIDE RING
13. COVER
14. WASHER
15. PIVOT WASHER
16. SPRING
17. LOCKNUT

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Figure 5-25.—Fuel pressure switch.

terminates whenever the water level sensing switch closes. When the water level sensing switch is finally activated, the timer starts running and the agitation operation commences.

The AGITATION operation function is to provide washing and rinsing of the laundry once the tub is filled with water. There are two basic methods of washing action in general use. One is a reciprocating agitator that swirls the water and clothes back and forth in a tank. The other is a rotating drum that picks up the clothes and allows them to drop into a pool or stream of water. Most automatic washers are of the agitator, top-loading variety.

The SPIN operation function is to remove excess water from the laundry fabrics. During this operation, the main drive motor spins the laundry tub at a relatively high rate of speed, forcing water out of the tub and laundry fabrics by means of centrifugal force. The drain pump removes this spun-out water from the washer; therefore, the DRAIN operation function is to pump the used wash water and rinse water out of the washer and into the wastewater system.

Modern automatic clothes washers include a number of optional features that do not appear as necessary parts of the timing diagram. The more common options are as follows:

- Most washers have a high/low water level selector switch; some give the user a choice of high, medium, and low water levels; and a few washers have an "infinite" water level adjustment that lets the user set the water to any desired level. The purpose of such a switch is to conserve water whenever the laundry tub is only partially filled with laundry. Some washers do not have a water level selector switch, and all wash and rinse phases run with the tub filled to capacity.

- In most washers you normally have access to a set of switches, push buttons, or a dial that allows a choice of water temperatures. Newer and better washers have separate selector switches for the wash water and rinse water phases; hot water, warm water, or cold water for the washing phase; and warm water or cold water for the rinsing phase. In the simplest washers, the switch might only permit a selection of either hot or cold water for both the washing and rinsing phases of the wash cycle.

- The agitation speed selector lets you select a normal or gentle speed for the agitation action. The gentle speed is used only in instances where there is a chance that normal speed might harm certain types of fabrics. It is important to note that this speed selector switch does not influence the timing in any way. For example, if you set up a 10-minute washing operation, the operation occupies a full 10 minutes whether the agitator speed is set to normal or gentle.

Operation

An automatic washer can be an elaborate piece of electromechanical equipment. Most modern washers have a number of basic electrical and mechanical parts that work much the same way in every make and model. The primary parts include the following:

1. a timer assembly,
2. solenoids for controlling the inflow of hot and cold water,
3. a transmission and a main drive motor for providing the powerful agitation and spin actions,

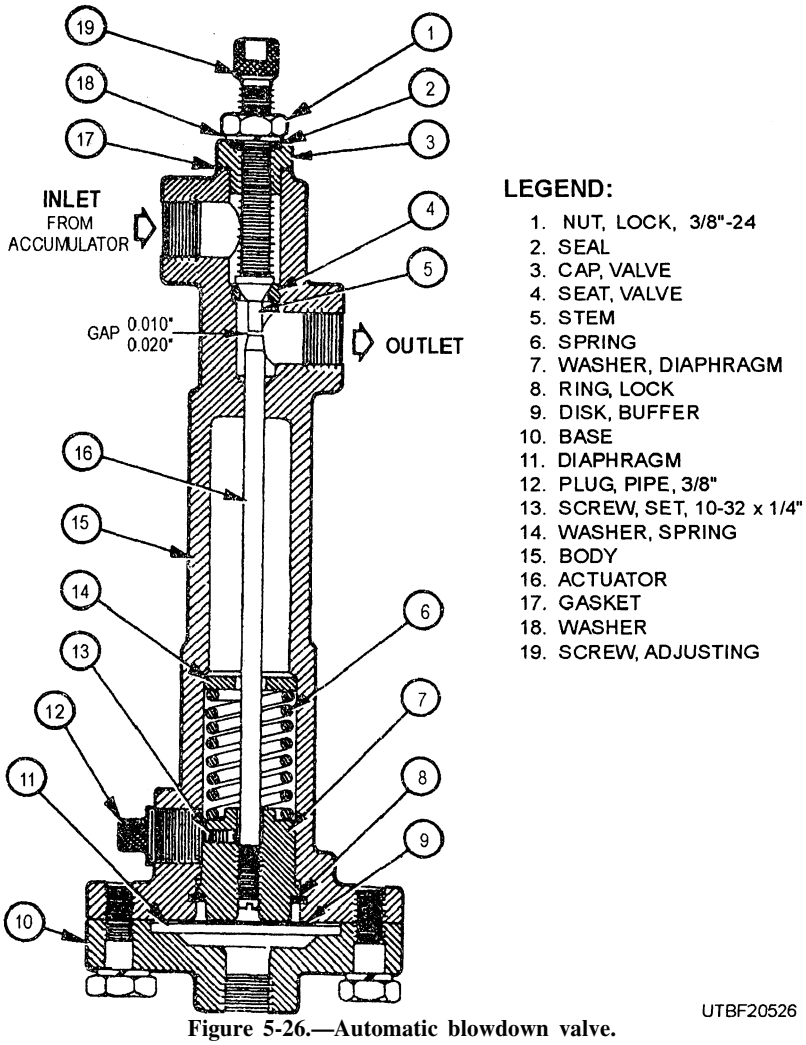


Figure 5-26.—Automatic blowdown valve.

4. a water pump assembly for recirculating and removing water from the washer, and

5. a host of controls and switches.

These components are discussed in terms of what they do and how they do it in the following paragraphs.

TIMER ASSEMBLY.—The timer assembly is the "brain" of the automatic washer. The timers found in automatic washers are not much different from those found in some other major appliances, including automatic dryers and dishwashers. The cam-operated switch contacts are responsible for starting and stopping most of the basic washer operations.

The basic elements of a timing switch assembly are a split-phase motor, a set of cams, and some contact switches. The motor, usually geared down to a speed of about one-half revolution per hour, turns a set of cams that open and close banks of switch contacts. The switch contacts control the flow of line power to the various electrical devices in the washer.

TRANSMISSON ASSEMBLY.—The transmission in an automatic washer is the most complex piece of mechanical machinery in the appliance industry. The transmission is wholly responsible for converting the rotary motion of the main drive motor into either an agitating motion or spinning action. Although there is often a direct linkage between the drive motor shaft and the cam assembly that produces the agitating motion, the motor is connected to the spin section of the transmission by means of a friction clutch that lets the laundry tub reach its normal spinning speed gradually without overloading the motor.

In some current models, the transmission is shifted from one type of action to another by means of a solenoid-operated gearshift. The majority, however, shift between agitate and spin according to the

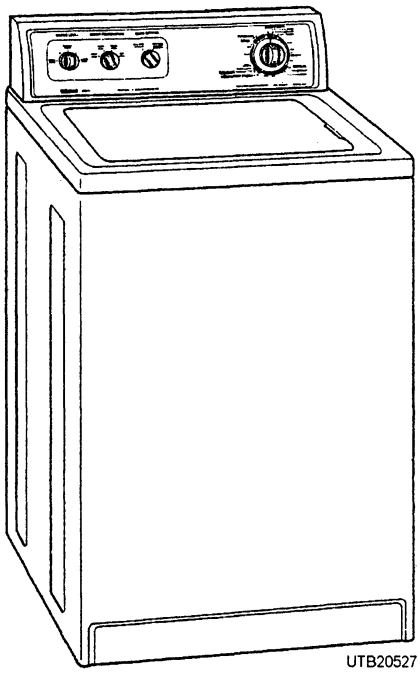


Figure 5-27.—A typical automatic residential washer.

direction the drive motor spins. Whenever the drive motor turns in one particular direction, the transmission is shifted to the spin gear. Reversing the motor then automatically shifts the transmission to its agitate gear.

Some washing machine transmissions also have a neutral gear that allows the drive motor to turn without causing either the spin or agitation action to occur. This feature is used during drain operations that call for running the water pump by itself.

MAIN DRIVE MOTOR.—The main drive motor is responsible for converting electrical energy into the kind of mechanical power that is necessary for carrying out the agitation, spin, and pumping actions of the washer. The motor is normally a split-phase induction motor that is rated at about one-half horsepower. Washer motors, almost without exception, operate on 120-volt line power.

A capacitor-start feature is not necessary for washing machines using fractional horsepower drive motors, but a centrifugal switch or relay-start mechanism is always an integral part of the control system of the main drive motor. In some cases, you will find that washer motors are also reversible and they sometimes have built-in speed control windings.

WATER PUMP ASSEMBLY.—The primary purpose of the water pump is to draw used water out of the washer at the end of the washing and rinsing steps and during spin operations. The pump is also used to recirculate the wash and rinse water with the use of a lint filter. The water pump is mechanically driven by the transmission and main drive motor and is operating anytime the main drive motor is running. Consider now the fact that the main drive motor is reversible in most models. It runs in one direction for agitation operations and in the opposite direction for spin operations. This means the water pump runs in both directions as well; and the logical conclusion is the pump moves water in two different directions, depending on which way the main drive motor is turning.

It is possible to take advantage of this two-direction characteristic of the water pump by using it in conjunction with a two-way flapper-valve assembly. The idea is to recirculate the wash or rinse water during agitation operations and to pump the water out of the system during spin operations. By turning the drive motor and pump in the agitation direction (fig. 5-28, view A), valve A is opened and valve B is closed. The water is thus routed through the water recirculation system inside the machine. By turning the drive motor and pump in the spin direction (fig. 5-28, view B), valve A is closed and valve B is opened. Since valve B leads to the wastewater system, moving the water in that direction effectively drains it all out of the washer. This makes it possible to use a flapper-valve assembly for routing the water without using extra electrical controls and timer switches. Some washers control the routing of the pump water by means of solenoid valves.

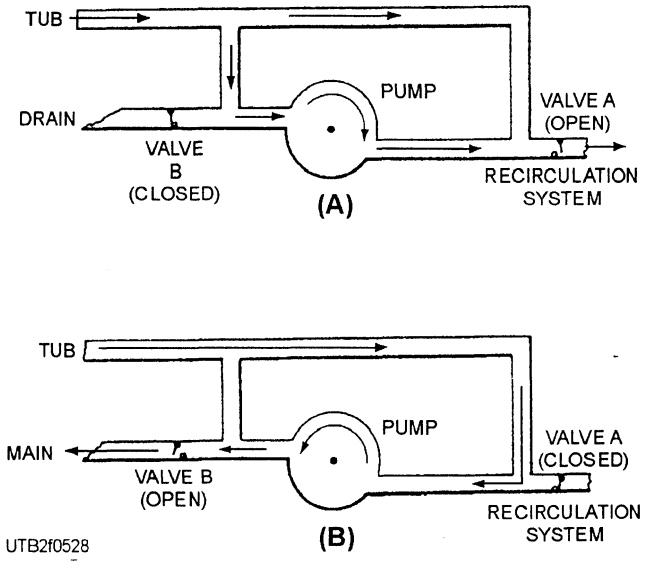


Figure 5-28.—Operation of a flapper-valve water control system: A. Pump turning in the agitate direction to recirculate the water; B. Pump turning in the spin direction to pump water out of the washer.

WATER VALVES.—The water valves control the inflow of hot and cold water during fill operations. The valves are electrically operated, as shown in figure 5-29. The solenoids are turned off most of the time, keeping their respective valve ports closed. The ports open only when electrical power is sent to the solenoid windings.

The two water valve solenoids can be operated individually or at the same time. Activating the "hot" valve, for instance, fills the washer with hot water. Energizing the "cold" valve fills the washer with cold water, and energizing both valves at the same time fills the washer with warm water—a mixture of hot and cold.

The water temperature selector switch determines the water valves to be operated during any given fill operation; timer contacts are responsible for energizing the selected solenoids at the appropriate times.

A typical water-fill circuit for modern automatic washers is shown in figure 5-30. The hot- and cold-water solenoid valves are energized through several sets of timer contacts and a water temperature selector switch assembly.

WATER LEVEL SENSING SWITCH.—Washers that do not use a timed-fill interval must have provisions for sensing the water level and turning off the water supply whenever a given water level is reached. This sensor normally takes the form of a pressure switch that is activated either directly by the water pressure on the bottom of the laundry tub or indirectly activated by air pressure in a tube located at the rear of the washer.

The diagram in figure 5-31 shows the operation of the indirect, or air pressure, sensing mechanism. The water level in the tub is always the same as the water level in the washer. As the water level rises, the air pressure at the top of the tub increases. A pressure switch at the top of the tub can be adjusted to close at various pressure levels, representing different water levels in the washer.

DOOR INTERLOCK SWITCH.—The door interlock switch is a safety feature that completely shuts down the washer whenever the door or lid is opened during a spin operation. Opening the door during any other part of the cycle does not affect the ongoing operation.

The diagram in figure 5-32 shows how the door interlock switch is bypassed by a timer contact. The timer contact is closed throughout most cycles of the washer, allowing the lid switch to be opened without interrupting current flow to the motor circuit. During every spin operation, however, the timer opens the bypass switch, letting the lid switch interrupt the complete circuit to the motor whenever the lid is opened during that particular operation.

This list of mechanical and electrical components is not complete as far as the full range of modern clothes washer models is concerned. This list is complete, however, in the sense that it describes the most critical components and those that are unique to clothes washers.

Installation

Satisfactory performance of an automatic washing machine depends on a carefully planned and properly designed first installation. The place where the laundry is done should be well lighted and adequately equipped with convenient electrical outlets. The plumbing connections must be anchored to the floor to prevent movement.

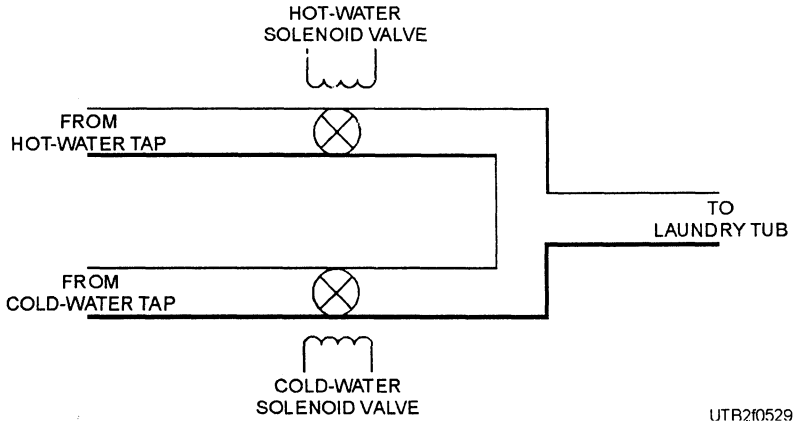
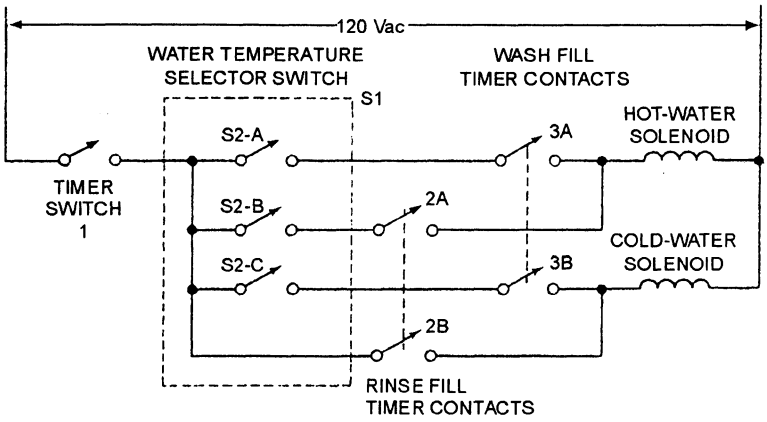


Figure 5-29.—Hot- and cold-water solenoid valve control system.



SELECTED WATER TEMPERATURE		S1 CONTACT CONFIGURATION		
WASH	RINSE	S1-A	S1-B	S1-C
HOT	WARM	X	X	0
HOT	COLD	X	0	0
WARM	WARM	X	X	X
WARM	COLD	X	0	X
COLD	WARM	0	X	X
COLD	COLD	0	0	X

X = CLOSED
0 = OPEN

(B)

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Figure 5-30.—Water temperature selector circuit: A. Circuit diagram; B. Switch closes for different combinations of wash and rinse water temperatures.

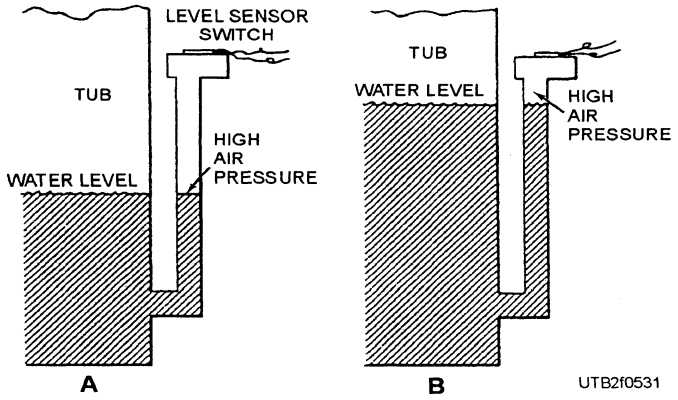

Figure 5-31.—A water level sensor scheme: A. Water level below the set point on the sensor; B. Water level at the set point.

Various local code regulations apply in most communities to permanent plumbing and electrical installations; however, local codes and military specifications can vary. The National Plumbing Code and NAVFACENGCOM guide specifications also provide installation requirements. Figure 5-33 shows an installation that meets the requirements of the National Plumbing Code. In summary, installation depends upon where you are. In a conflict, what the ROICC (Resident Officer in Charge of Construction) says is the final word.

Troubleshooting

Now you know what the components in a washing machine do and how they do it. Use the trouble-shooting chart in table T of appendix II as a guide or checklist for some of the common problems, causes, and ways to fix them.

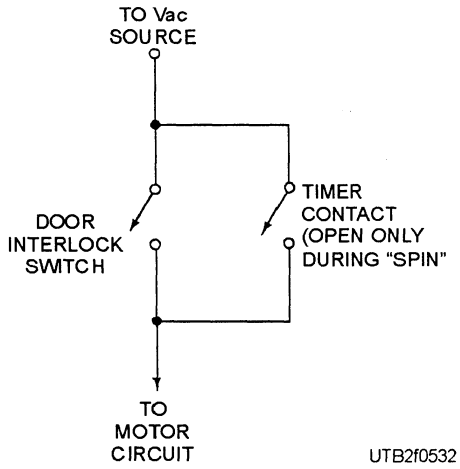

Figure 5-32.—Door switch and override circuit.

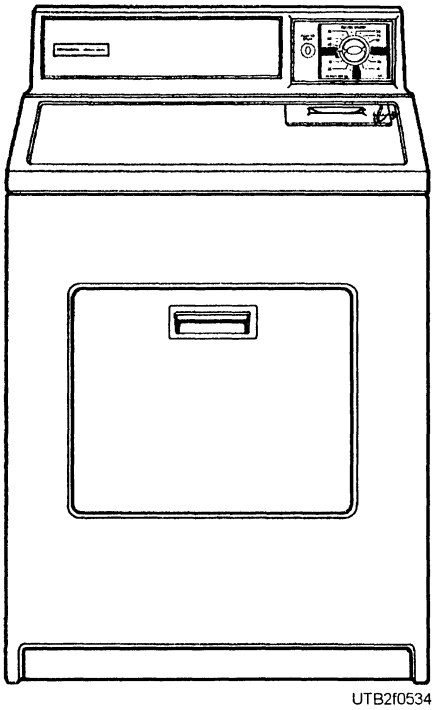

Figure 5-34.—A typical residential dryer.

RESIDENTIAL CLOTHES DRYERS

Automatic clothes dryers (fig. 5-34) have two primary advantages over the old clothesline process. First, the laundry drying job is much faster with the automatic dryer. The user does not spend as much time setting up the process and the actual drying operation takes less time. The other advantage of an automatic drying scheme is that it can be used at any time of the day, in any season of the year, and under any sort of weather conditions.

Depending on the type of heat energy used, clothes dryers may be divided into two general classes—electric dryers and gas dryers. The source of heat in the electric dryer is obtained electrically by a heating element mounted in the dryer. A centrally located thermostat and timer control the heating element. In a gas dryer, the source of heat is derived from ignited gas, which is obtained by turning on the gas flow; however, a pilot light must first be burning in the combustion chamber. This pilot ignition is automatic; lighting takes place when a spark is created by turning a knob usually on the dryer control panel.

All dryers, irrespective of heating methods used, are equipped with a forced-air blower to draw in fresh air, force it through a heating assembly, and then

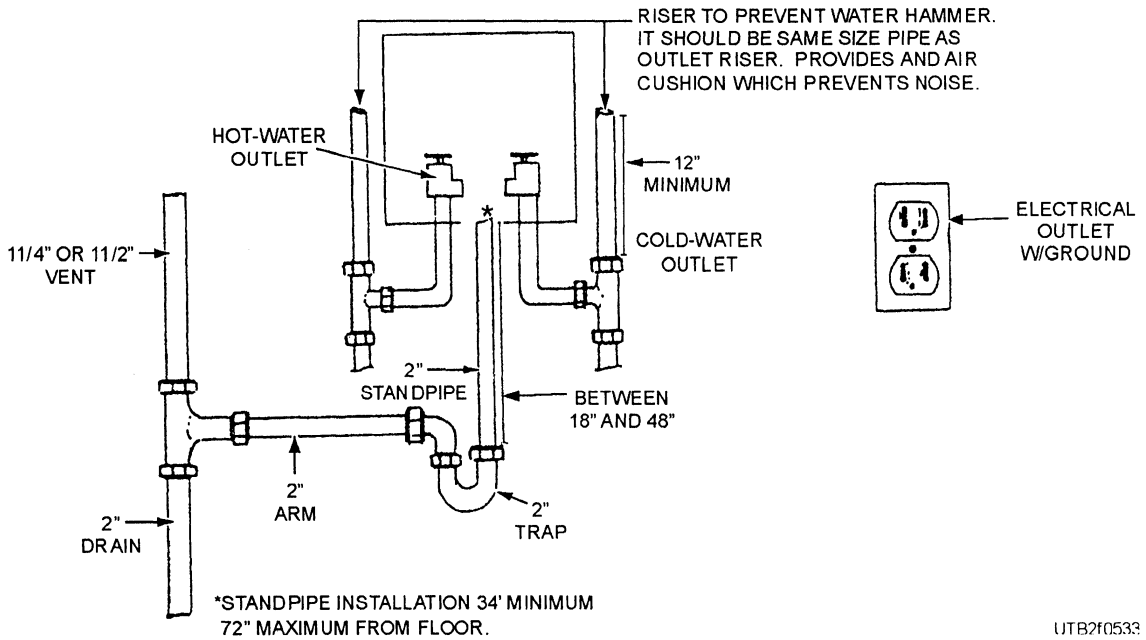

Figure 5-33.—Automatic washer installation.

channel it into the rotating hamper. The warmed air picks up moisture from the laundry, as it passes through the hamper. The blower finally directs the moisture-laden air through a lint filter that traps most of the dry, lightweight particles of lint and other foreign materials picked up by the moving air before the air is discharged from the dryer.

The heating assembly in an all-electric dryer consists of a set of nichrome heating elements situated in the forced-air steam. The heating assembly in a gas dryer performs exactly the same function, but it uses gas flame heat.

The electrical sections of modern clothes dryers can be rather simple compared to some other kinds of modern appliances. The basic electrical units of a dryer include heating controls that maintain a fairly constant drying temperature and a timer mechanism that turns off the dryer at the end of a selected drying interval. The essential differences between the simpler dryer models and the top-of-the-line versions can be found in the number and types of heat and timer controls.

All automatic dryers include a basic cycle that is normally labeled a "Timed Cycle"" on the timer control knob. When operation is done in this mode, the dryer tumbles the laundry continually and regulates the level of the forced air throughout the entire drying interval. The tumbling and heating actions both stop at the end of the selected drying time. You can set the drying interval to any point between zero and about 180 minutes, depending on the amount and wetness of the load.

Operation

Automatic clothes dryers operate on a simple principle, involving the following essential parts:

- An exhaust fan
- Automatic controls
- A perforated metal drum
- An electric motor to rotate the drum
- A source of heat—either gas or electric.

In operation, wet or damp clothes are placed into the drum, and after the door is closed, the thermostatic control is set to the correct heat level; the timer is also set to the desired running time. The best temperature and running time combination depends on the type of clothing, the material of which it is made, the weight of the clothing, and the amount of water it contains. The correct combination for various loads is normally indicated on a chart near the control knobs; if not, consult the owner's manual.

Once the correct control combination has been set, the drum begins to rotate at about 50 revolutions per minute, and the heat turns on to start the drying function. Air circulation is provided simultaneously by the motor-driven fan, circulating the heated air through the clothing. Baffles on the sides of the drum tend to carry the clothes to the top of the dryer drum, at which time they drop to the bottom. These baffles prevent the clothes from lumping together and provide a tumbling action that speeds up the drying process. The door may be opened at any time during the cycle. When the controls are functioning properly, any opening of the dryer door stops the dryer cycle, turning off the heater and other motors. If more time remains in the cycle, the drying action resumes when the door is closed; in some cases, the start button must be pressed.

Although a motor drive belt may break from time to time or a bearing becomes jammed, most problems involving automatic clothes dryers are in the automatic controls. In most cases, the contacts become worn, wiring becomes short-circuited or open, and so on.

Installation

When installing a dryer, either a new one or one that has been repaired, observe all codes and ordinances that apply to the particular dryer. The information below will help you in installing, repairing, and locating a dryer. Leave enough space around the dryer for ease of installation, use, and service.

If the dryer is to be installed in a confined area, such as a closet or bathroom, it must be exhausted to the outside. Furthermore, it must have enough space around it and enough air circulation to operate properly.

The electric service should conform with the National Electric Code as well as local codes and ordinances. When gas is used as the heat source, the installation must conform to the National Fuel Gas Code and local codes and ordinances.

Never exhaust the dryer into a chimney or any other duct or vent. The dryer must have its own exhaust system. Before putting a dryer into use after installing or servicing, replace all access and service panels. If still attached, read and follow all caution and direction labels attached to the dryer.

While servicing, review the wiring diagram that accompanies the dryer. This diagram is usually

attached to the access panel. The dryer vent should not exceed a maximum length of 4 feet primarily because the buildup of condensation increases the time required to dry the clothes.

Troubleshooting

You need to be acquainted with the operation and functioning of both the mechanical and electrical systems. Although the various types of clothes dryers may differ in appearance and location of controls, they all operate on the same principles and are fundamentally similar in servicing. Clothes dryer timers are quite similar to those on an automatic washing machine, while thermostats used in automatic dryers are the same type as those used on electric ranges.

Since the only moving parts consist of the motor, drive, drum, and exhaust fan, the clothes dryer, when properly installed, should give years of trouble-free service. When called on, the service personnel should be familiar with the recommendations and specifications of the particular manufacturer's service manual to replace any worn-out or faulty component correctly. When a dryer does not operate properly, always try the service manual first. However, table U of appendix II may be used for further troubleshooting and repair should it become necessary.

Q12. What is the maximum operation time that can be provided by the formula chart on the Milnor washer?

Q13. The automatic supply injector of a washer consists of how many compartments?

Q14. The automatic drain valve for a washer requires a minimum of whatpsi?

Q15. The supply injector solenoid valves can handle what maximum psi?

Q16. How often should the gearbox oil level be checked?

Q17. Extractors are eq uipped with either an automatic or manual brake. True/False.

Q18. When installing an extractor, you should check the equipment nameplate before connecting the power source for what reason?

Q19. An opening of how many square feet must be provided for a 3,000 cfm dryer for proper ventilation?

Q20. The electric motors on a tumbler should be cleaned and inspected annually.' True/False.

Q21. The Clayton steam generator can develop its full-rated capacity from a cold start in what length of time?

Q22. When. installing a boiler, you should always use what manual?

Q23. Reduced burner efficiency can be caused by dirt or lint on what device?

Q24. What are the four basic operations of a residential washer?

Q25. What component converts electrical energy into mechanical power necessary to carry out washer operations?

Q26. What are the two classes of residential dryers?